

What is claimed is:

1. A sensor, comprising;
a laser element, producing a diverging beam; and
a single substrate, including a first diffractive
5 optical element placed to receive the diverging beam and
produce a fringe based thereon, a scattering element which
scatters said fringe beam based on particles being
detected, and a second diffractive element receiving
scattered light.

10 2. A sensor as in claim 1, wherein said single
substrate includes a first surface which includes both said
first and second diffractive optical elements.

15 3. A sensor as in claim 2, further comprising a
second surface, opposite said first surface, including a
pattern formed thereon which receives particles crossing
the pattern, and light crossing the particles being
collected as said scattered light.

20 4. A sensor as in claim 1, further comprising a
detector, receiving said scattered light, and producing a
signal indicative thereof.

5. A sensor as in claim 4, further comprising a housing, wherein said laser element, said single substrate, and said detector are coupled within said housing in a way which holds all of said elements in registration with one another.

6. A sensor as in claim 1, wherein said substrate is a substrate formed of a quartz.

10 7. A sensor as in claim 1, wherein said quartz substrate is less than a 1000 microns on each side.

15 8. A sensor as in claim 6, wherein said quartz substrate has a first surface with said first and second diffractive optical elements formed thereon and a second surface with diverging fringes which is placed in an area of light collection.

20 9. A method of measuring particles, comprising:
placing a first surface of a transparent substrate into contact with a source of particles;

illuminating said particles with a laser via a diffractive optical element on a first surface of said

substrate and receiving scattered light from said particles via a second diffractive element on said first surface; and monitoring said received light to determine information about said particles.

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10. A method as in claim 9, wherein said diffractive elements are formed by depositing PMMA on the surface of the substrate.

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11. A method as in claim 9, wherein said substrate is formed of quartz.

12. A method as in claim 9, further comprising forming alignment marks on opposite sides of the substrate.

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13. A method as in claim 12, wherein said alignment mark are formed as positive structures on one side, and lack of positive structures on the other side.

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14. An integrated shear stress sensor, comprising:
a housing;
a laser diode coupled to said housing in a location to emit light from a top of said housing;

a sensing element, formed by a transparent substrate, having a first surface adjacent said laser diode to receive illumination therefrom and a second surface adjacent a top portion of said housing to sense particle movement; and

5 an optical sensor, also coupled to said housing, coupled adjacent to said substrate to receive collected light therefrom.

15. A sensor as in claim 14, wherein said first
10 surface of said substrate includes two diffractive optical elements, a first optical element receiving said laser beam from said laser beam, and a second of said optical elements receiving collected light.

15 16. A sensor as in claim 15, wherein said diffractive optical elements are formed from PMMA layers on the substrate.

17. A sensor as in claim 14, further comprising
20 optical slits on the second side of the substrate forming a fringe pattern in an area of said second side of said substrate, said fringe pattern interfering with said particles.

18. A sensor as in claim 14, wherein said optical sensor includes an avalanche photodiode.

19. A method of sensing particles, comprising:
5 illuminating particles with a photodiode via a series of slits which form a fringe pattern; and
detecting interference with said fringe pattern as detecting particle flow.

10 20. A method as in claim 19 wherein said detecting comprises detecting shear stress.

21. A method as in claim 19, wherein said detecting comprises detecting particle size.

15 22. A method as in claim 19, wherein said illuminating comprises forming two beams, and recombining said two beams to form said fringe pattern.

20 23. A method as in claim 22, wherein said two beams are formed by a laser producing two output beams.

24. A method as in claim 22, wherein said two beams are formed by a single grating with a blocked part.

25. A method as in claim 19, wherein said detecting comprises detecting light in two locations, and determining a phase shift therebetween.

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26. A method of determining particle size, comprising:

forming an output of a laser;

10 interfering said output of said laser along two separate paths with a third laser beam, at a location where said particle size is to be measured; and

using said interference to measure the size of the particle.

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27. A method as in claim 26, wherein said using comprises detecting a phase shift between two separated receptors, which receive scattered light from said location.

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28. A method as in claim 26, further comprising guiding the laser along two separate paths on a substrate; forming a grating on the substrate which causes the laser to follow said paths; and

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detecting a particle above said substrate based on
interference caused by said grating.

29. A method as in claim 26, further comprising
5 locating a plurality of photodetectors in respective
locations where they can sense interference of said laser.

30. A sensor system comprising:

a substrate;

10 a laser, mounted on said substrate to produce two
outputs;

gratings, located in said two directions, to modify
said laser beam and produce another beam in a area of a
particle whose characteristics are to be detected; and

15 a detector, using an interference between said two
beams to determine said characteristics of said particle.

31. A system as in claim 30, wherein said laser
produces outputs in two different directions.

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32. A system as in claim 30, wherein said laser
produces a single output which is separated.

33. A system as in claim 30, further comprising photodetectors, mounted on said substrate to detect scattered light therefrom.

5 34. A system as in claim 30, further comprising photodetectors mounted above said substrate.

35. A particle sensor, comprising:

a semiconductor substrate;

10 a laser element, mounted on said semiconductor substrate, and producing at least one diverging beam;

a fringe producing element, producing a fringe in an area of a particle having characteristics to be measured; and

15 a detector, detecting scattered light from said fringe and said particles, and determining said characteristics of said particle from said scattered light.

20 36. A sensor as in claim 35, further comprising a single substrate, including a diffractive optical element placed to receive the beam, a scattering element which scatters light from the beam based on particles being detected, and a second diffractive element receiving scattered light.

37. A system as in claim 4, further comprising a semiconductor substrate, and wherein said laser and said detector are on the same semiconductor.